G.2 Bath Replacement Criteria for MHC Alternatives

Electroless Copper - Non-Conveyorized (Baseline)
Electroless Copper - Conveyorized
Non-Formaldehyde Electroless Copper - Non-Conveyorized[A]

Process Step	Bath Replacement Frequencies (ssf/gal) [1]						Frequency of Replacement Cost Simulation Inputs[3]	
	Process # 1	Process # 2	Process # 3	Process # 4	Process # 5	Average Frequency of Replacement [2]	Conveyorized (Panels)	Non-Conveyorized (Racks)
Cleaner/Conditioner	Conc.	228	500	300	1,000	510	5,920	396
Micro-Etch	Conc.	ND	250	ND	Conc.	250	2,858	194
Predip	Conc.	228	Conc.	400	1,000	540	4,822	418
Catalyst	300	Conc.	500	6 mos	Conc.	1/year	1/year	1/year
Post Dip/Acid Dip	ND	ND	1,000	ND	350	675	9,523	523
Accelerator	360	160	2,500 *	250	350	280	4,000	217
Electroless Copper	360	Conc.	500	ND	Conc.	430	14,206	334
Anti-Tarnish	200	ND	250	ND	500	325	2,264	252

ND = No Data
NA = Not Applicable
Conc. = Replacement data given in concentration (e.g, g/L Cu) so not usable in this analysis.
* - data point considered outlier and thus not included in calculation of average.
[A] Incomplete bath replacement data submitted for non-formaldehyde copper process. Therefore, the process was assumed to be similar to electroless copper for the purposes of bath replacement.
[1] Bath replacement frequency data for MHC product lines reported on product data sheets provided by chemical supplier of each individual process.
[2] Reported value was calculated by excluding any outlying values and then averaging remaining bath replacement data for each bath.
[3] To calculate panels per bath replacement, multiply average frequency of replacement by bath size in gallons and divide by 5.6 ssf/panel.
To calculate racks per bath replacement, multiply average frequency of replacement by 75 gallons (average bath size) and divide by 96.8 ssf/rack.

Carbon - Conveyorized

Process Step	Bath Replacement Frequencies (ssf/gal) [1]						Frequency of Replacement Cost Simulation Inputs[3]	
	Process # 1	Process # 2	Process # 3	Process # 4	Process # 5	Average Frequency of Replacement [2]	Conveyorized (Panels)	Non-Conveyorized (Racks)
Cleaner	300	NA	NA	NA	NA	300	2,340	NA
Carbon Black	1/year	NA	NA	NA	NA	1/year	1/year	NA
Conditioner	300	NA	NA	NA	NA	300	2,961	NA
Carbon Black	1/year	NA	NA	NA	NA	1/year	1/year	NA
Micro-Etch	ND	NA	NA	NA	NA	250**	2,855	NA

NA = No Data
NA = Not Applicable
Conc. = Replacement data given in concentration (e.g., g/L Cu) so not usable in this analysis.
** - Due to lack of replacement data, the frequency of replacement of the micro-etch bath was assumed to the same as for electroless copper.
[1] Bath replacement frequency data for MHC product lines reported on product data sheets provided by chemical supplier of each individual process.
[2] Reported value was calculated by excluding any outlying values and then averaging remaining bath replacement data for each bath.
[3] To calculate panels per bath replacement, multiply average frequency of replacement by bath size in gallons and divide by 5.6 ssf/panel.

Conductive Polymer - Conveyorized

Process Step	Bath Replacement Frequencies (ssf/gal) [1]						Frequency of Replacement Cost Simulation Inputs[3]	
	Process # 1	Process # 2	Process # 3	Process # 4	Process # 5	Average Frequency of Replacement [2]	Conveyorized (Panels)	Non-Conveyorized (Racks)
Micro-Etch	ND	NA	NA	NA	NA	250**	2,855	NA
Cleaner/Conditioner	408	NA	NA	NA	NA	410	4,681	NA
Cleaner/Conditioner	408	NA	NA	NA	NA	410	4,681	NA
Catalyst	4,880	NA	NA	NA	NA	4,880	11,985	NA
Conductive Polymer	1,935	NA	NA	NA	NA	1,940	8,918	NA
Micro-Etch	ND	NA	NA	NA	NA	250**	2,855	NA

NA = No Data
NA = Not Applicable
Conc. = Replacement data given in concentration (e.g., g/L Cu) so not usable in this analysis.
** - Due to lack of replacement data, the frequency of replacement of the micro-etch bath was assumed to the same as for electroless copper.
[1] Bath replacement frequency data for MHC product lines reported on product data sheets provided by chemical supplier of each individual process.
[2] Reported value was calculated by excluding any outlying values and then averaging remaining bath replacement data for each bath.
[3] To calculate panels per bath replacement, multiply average frequency of replacement by bath size in gallons and divide by 5.6 ssf/panel.

Organic Palladium - Conveyorized
Organic Palladium - Non-Conveyorized

Process Step	Bath Replacement Frequencies (ssf/gal) [1]						Frequency of Replacement Cost Simulation Inputs[3]	
	Process # 1	Process # 2	Process # 3	Process # 4	Process # 5	Average Frequency of Replacement [2]	Conveyorized (Panels)	Non-Conveyorized (Racks)
Cleaner	200	NA	NA	NA	NA	200	1,560	155
Micro-Etch	ND	NA	NA	NA	NA	250**	2,855	194
Conditioner	244	NA	NA	NA	NA	240	2,411	189
Predip	1/week	NA	NA	NA	NA	1/week	1/week	NA
Conductor	2,038	NA	NA	NA	NA	2,040	39,007	1,580
Post Dip	244	NA	NA	NA	NA	240	1,950	189
Acid Dip	200	NA	NA	NA	NA	200	2,801	155

ND = No Data
NA = Not Applicable
Conc. = Replacement data given in concentration (e.g, g/L Cu) so not usable in this analysis.
** - Due to lack of replacement data, the frequency of replacement of the micro-etch bath was assumed to be the same as for electroless copper.
[1] Bath replacement frequency data for MHC product lines reported on product data sheets provided by chemical supplier of each individual process.
[2] Reported value was calculated by excluding any outlying values and then averaging remaining bath replacement data for each bath.
[3] To calculate panels per bath replacement, multiply average frequency of replacement by bath size in gallons and divide by 5.6 ssf/panel.
To calculate racks per bath replacement, multiply average frequency of replacement by 75 gallons (average bath size) and divide by 96.8 ssf/rack.

Graphite - Conveyorized

Process Step	Bath Replacement Frequencies (ssf/gal) [1]						Frequency of Replacement Cost Simulation Inputs[3]	
	Process # 1	Process # 2	Process # 3	Process # 4	Process # 5	Average Frequency of Replacement [2]	Conveyorized (Panels)	Non-Conveyorized (Racks)
Cleaner/Conditioner	200	750	NA	NA	NA	475	5,443	NA
Graphite	Conc.	3,000	NA	NA	NA	3,000	19,415	NA
Micro-Etch	Conc.	ND	NA	NA	NA	250**	2,855	NA

ND = No Data
NA = Not Applicable
Conc. = Replacement data given in concentration (e.g, g/L Cu) so not usable in this analysis.
** - Due to lack of replacement data, the frequency of replacement of the micro-etch bath was assumed to be the same as for electroless copper.
[1] Bath replacement frequency data for MHC product lines reported on product data sheets provided by chemical supplier of each individual process.
[2] Reported value was calculated by excluding any outlying values and then averaging remaining bath replacement data for each bath.
[3] To calculate panels per bath replacement, multiply average frequency of replacement by bath size in gallons and divide by 5.6 ssf/panel.

Tin-Palladium - Conveyorized
Tin-Palladium - Non-Conveyorized

Process Step	Bath Replacement Frequencies (ssf/gal) [1]						Frequency of Replacement Cost Simulation Inputs[3]	
	Process # 1	Process # 2	Process # 3	Process # 4	Process # 5	Average Frequency of Replacement 2	Conveyorized (Panels)	Non-Conveyorized (Racks)
Cleaner/Conditioner	350	1,000	500	2 weeks	NA	610	6,879	465
Micro-Etch	Conc.	Conc.	250	Conc.	NA	250**	2,855	194
Predip	400	4,000*	500	Conc.	NA	450	3,972	349
Catalyst	3,000	Conc.	2,500	1,000	NA	1/year	1/year	1/year
Accelerator	500	1,000	500	400	NA	600	8,457	465
Acid Dip	500	ND	1,000	210	NA	570	7,961	442

ND = No Data
NA = Not Applicable
Conc. = Replacement data given in concentration (e.g, g/L Cu) so not usable in this analysis.
** - Due to lack of replacement data, the frequency of replacement of the micro-etch bath was assumed to be the same as for electroless copper.
[1] Bath replacement frequency data for MHC product lines reported on product data sheets provided by chemical supplier of each individual process.
[2] Reported value was calculated by excluding any outlying values and then averaging remaining bath replacement data for each bath.
[3] To calculate panels per bath replacement, multiply average frequency of replacement by bath size in gallons and divide by 5.6 ssf/panel.
To calculate racks per bath replacement, multiply average frequency of replacement by 75 gallons (average bath size) and divide by 96.8 ssf/rack.